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The error of my watch which is to be applied to those times was

$$+\ 8^{m}\ 12^{s}.9$$

and thus the time of the maximum may be put down as

$$12^{h}\ 45^{m}\ 43^{s}$$

The meteors with very few exceptions seemed to radiate from a point situated on the line joining γ and ε *Leonis*, in which a perpendicular let fall from ζ meets this line. The Right Ascension and Declination of this point is according to Bode's maps; $\alpha = 150^{\circ}$ and $\delta = +22^{\circ}$, and for 1866 November, $\alpha = 150^{\circ}\ 26'$ and $+21^{\circ}\ 41'$.

On the Meteoric Shower of November 13–14, 1866. By W. Masters, Professor at Kishnaghur College, Bengal.

(*Communicated by Sir J. W. F. Herschel, Bart.*)

My attention was first drawn to the November meteors in 1833 (I believe), when a little before sunrise, while seated in an upper verandah in Calcutta, and looking south, I observed white, pearly, flaky, I might almost say tiny spiritual things of the shape of Rupert-drops, falling, as I fancied, perpendicularly down, about a yard or two apart, and about fifteen succeeding each other in two or three minutes, within the range of direct vision. Day followed too quick for this exhibition to last long.

Since that time I had been watching their recurrence year after year without success, and was on the look out for them from the 9th to the 13th inst., when only a few stragglers presented themselves. Up to 11 P.M. of the 13th there was no sign of meteors; but at half-past 4 A.M. of the 14th inst. they were in great abundance over Kishnaghur, in Bengal, about fifty-seven miles due north of Calcutta. I cannot say at what hour they first began to fall, although I have made inquiries of police-watchmen and others. I looked out about half-past four or a quarter to five, and observed them shooting along the sky divergingly and very rapidly from some part of the head of *Leo Major;* and from their manner of comporting themselves was immediately convinced that we had come upon the great shoal of November. I was most interested in detecting if possible the precise point of divergence, and it soon became evident that, contrary to received opinion, γ *Leonis* was not the starting point. After counting fifty in about five minutes, I woke up

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four other persons to witness the phenomenon and give aid in watching and counting.

We arranged ourselves looking in different directions, and as each saw a meteor there was a distinct call of the next number, 51, 52, 53, &c.; the stars shooting out sometimes faster than they could be counted. Some were lost on this account; some owing to the excitement of my youthful coadjutors; and many while I was waking up aid. Yet in less than half-an-hour we counted 420; had we been all together during the half-hour we would certainly have counted more than 500.

The velocity of these meteors was exceedingly great; there was no lagging or hesitation in their course, as is frequently the case with ordinary meteors; but they darted like rockets from an unseen centre, sometimes three or four in one direction nearly, slightly diverging, leaving long and short trains with much divergence horizonwards and narrow convergence upwards. I shall call these α for reference in the sequel. Others shot in different directions East, West, North, and South, and intermediate points were filled up in rapid succession; not one appeared to fall perpendicular to the Earth; all described glowing arcs in the sky varying from 20° to 60°, a few points of light excepted which described scarcely 3° or 4°.

Their decided and long courses, all seeking the horizon directly, and their persistent trains of light, which looked like meridians on a globe, strongly and unmistakably pointed to a spot in the head of *Leo Major*, then some degrees eastward of zenith, as their radiating point. To a spectator not anticipating such a phenomenon, the rush of fiery stars from an unseen centre overhead to the horizon all round must have been powerfully astonishing; even the unsurprised spectator was impressed with awe. A mad career of stars shooting across the heavens in varying and interlacing directions might create bewilderment and dread in all beholders; but these, though hurrying swiftly on some important errand, betokened order and law, and filled the mind with feelings of beauty and sublimity.

The meteors did not actually start into view at one point; many commenced their courses about 30° or 40° from the supposed point of divergence, seeking the different points of the horizon, while the upper portion of their trains pointed to the same spot in the sky. These were generally large and bright and illumined the trees and walls like a flash of lightning from a thunder-cloud near the horizon; others, comparatively small, darted or showed themselves only a few degrees from the radiating centre, sometimes three at once, leaving their trains tracing backwards. Those with long trains and long courses generally burst or blazed out about 20° or 30° from the horizon; some within 20° of it. No sound of any kind was heard; the light of these meteors when they blazed out was reddish; the trains behind were generally broad, spreading

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about half a degree, glowing at first like the fresh mark of phosphorus on a wall, then quickly becoming pale like the tail of a comet, or like the mingling of muriatic acid gas and ammonia, and lasting from half a minute to one minute and a half.

One took me quite by surprise; it blazed out like a star of the 2nd or 3rd magnitude between ε and μ of *Leo Major*, as bright as ε, but not of the same silveriness or intensity, and gradually faded away in the same spot without any visible linear course whatever; it suggested the idea of a meteor coming straight to the eye.

I looked out again at 6 A.M. before the sun rose, and saw a streak of white light, like a Rupert's-drop with a long thread behind, shoot down from the direction of *Leo Major* to *Capella; Alajoth* in the North-west the only star then visible. The meteor appeared to be close at hand, and looked exactly like those of 1833, with the exception of the long thread. About three or four of the meteors enumerated above did not shoot from the diverging point; if they belonged to the same set they must have been drawn out of their course.

After as careful a survey as the phenomena would permit, I have no doubt that the centre of radiation was somewhere between the two stars in the head of *Leo Major*, viz. ε and μ; and probably at the precise spot where a meteor appeared and disappeared. I saw one meteor start a few degrees North of μ scarcely 3°, to a point between North and North-east, and its course traced backwards passed nearly straight over μ and ε, and the clear impression of the moment on my mind was that a line darted from ε across μ and onward, the line becoming a meteor some distance further on. Again, the set of three or four which I have called α above, shot south-eastward, leaving *Regulus* a little to the east, starting nearly on a parallel with *Regulus*, their pale traces left in the sky converged unmistakably up to ε and μ as per margin; one trace proceeding a little more north than the other, and the meteor noticed above, which blazed out between these two stars, appears to reveal the true point of divergence. I have put a mark between the two to indicate the spot, nearer to ε than to μ; and were it not for this meteor I should have fixed upon ε as the diverging point. Some point near γ *Leonis* was the diverging point in 1833. If other observers confirm my statement, some step, I imagine, will be gained towards the determination of the orbit of the November shoal.

μ
•
ε

On the supposition that the meteors are not self-luminous, but become visible after contact with our atmosphere, it would appear that the atmosphere was unpierced by any meteors, two excepted, to a distance of about 10° at most all round ε.

The apex of the Zodiacal light appeared to be some degrees south both of ε and γ *Leonis*.

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An "observer" at Sealkote states that he saw meteors from midnight of the 13th to the dawn of the 14th inst.

There is a report that the meteors were seen at Lahore "to clash against each other and mount upwards again."

27*th Nov.* 1866,
Kishnaghur.

The Meteors of December 12–13, 1866, *as observed at Millbrook, Tuam.* By J. Birmingham, Esq.

Though the December meteors could not be compared to the wondrous display of the previous month, still in scientific interest they may be considered quite equal to their more brilliant precursors; and as I have not seen them noticed by other observers I am the more induced to offer the following brief account of them for the consideration of the Society.

There was great rain for two hours before 9 P.M. on the 12th, when it began to clear, and at $9^h\ 15^m$ I saw a small meteor going south from *Gemini.* Within the next fifteen minutes I observed nine others shown by alignments to radiate from within a circle about 3° in diameter, with its centre in Right Ascension 107° and North Polar Distance 71°. However, a slightly elongated and almost stationary meteor which appeared at the intersection of lines joining β and ϵ, δ and θ *Geminorum* would seem to indicate a somewhat higher radiant; and, as the night advanced, a few of the meteors proceeded from other places in the neighbourhood of *Gemini.* Regarding the tangent of the Earth's course on the night in question as directed towards 171° of longitude, it will be seen that the December radiant shows an orbit differing widely in relation to our own from that of the November group. Up to $1^h\ 25^m$ on the morning of the 13th I counted 260 meteors diverging to every point in the heavens, but the greater number fell towards the horizon between the south and the north-west. Unlike the full, glowing disks that traversed the sky on the 14th November, the present meteors might be described as having a *cindery* aspect, with, however, some notable exceptions. They were mostly of a bluish white colour; and red was to be found only among those that showed no connexion with the radiating movement, and of which I counted twenty. Though many appeared as trainless sparks, they generally showed tails that differed from those of the November meteors, as they were always of the same colour as the nuclei and left no cloudy traces after their extinction—facts suggestive of the idea that they were merely optical. One that was brighter than *Sirius* passed close to that star, as did another with equal